

REMARKS

Examiner J. Maldonado is thanked for the thorough examination and search of the subject Patent Application. Claims 1 and 9 have been amended. Claims 4, 5, 7, 8, 13, 14, 16, 17, 22, and 23 have been canceled.

All Claims are believed to be in condition for Allowance, and that is so requested.

Reconsideration of Claims 1-3 and 6 rejected under 35 U.S.C. 103(a) as being unpatentable over Rhodes et al (U.S. 4,536,951) in view of Huang et al (U.S. 6,180,509) and in view of Liu (U.S. 5,693,568) and Pangrie et al (U.S. 6,713,382 B1) is requested based on Amended Claim 1 and on the following remarks.

Applicant has amended Claims 1 and 9 to now include the limitation, formerly taught in Claim 8, where an anti-reflective coating layer of titanium nitride is deposited over the second metal layer prior to etching the second metal layer. In particular, Amended Claim 1 now reads:

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1. (Currently Amended) A method of forming self-aligned, anti-via interconnects in an integrated circuit device comprising:

providing a semiconductor substrate;

5 depositing a first metal layer overlying said semiconductor substrate;

depositing an etch stop layer overlying said first metal layer wherein said etch stop layer comprises a tungsten containing film;

10 depositing a second metal layer overlying said etch stop layer;

depositing an anti-reflective coating layer comprising titanium nitride overlying said second metal layer;

15 etching through said second metal layer, said etch stop layer, and said first metal layer to form connective lines;

thereafter etching through said second metal layer to form vias;

20 thereafter depositing a dielectric layer overlying said vias, said connective lines and said semiconductor substrate ~~wherein said dielectric layer is SiOF (fluorinated silica glass), SiOC (C substituted siloxane), amorphous SiC:H, MSQ (methylsilsesquioxane), porous materials, PPXC polymer (poly(chloro p xylylene), PPXN~~

25 ~~polymer (poly p-xylylene), or VT 4 (tetrafluoro p-~~
~~xylylene)~~; and

polishing down said dielectric layer to complete said
self-aligned, anti-via interconnects in the
manufacture of the integrated circuit device.

Applicant believes that the Examiner has referenced U.S.
Patent 6,080,660 to Wang et al as prior art to the subject
application under 35 U.S.C. 103(a). In particular, Wang et al is
referenced as teaching the use of an antireflective coating
comprising titanium nitride. However, Applicant respectfully
points out that Wang et al appears to teach against the use of
titanium nitride as the anti-reflective coating. In particular,
column 2, lines 19-33 reads:

"Aside from forming voids in the via, the conventional
method of forming a via has some other defects as well. For
example, the titanium/titanium nitride composite layer 14 that
forms over the conductive layer can serve as an anti-reflection
coating as well as an etching stop layer. **However, the existence**
of a titanium/titanium nitride composite layer 14 can easily
lead to a high and non-uniform via resistance due to Rv
scattering. Furthermore, the layer 14 enhances the misalignment
problem when a photolithographic alignment is performed. Hence,

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etching operation becomes more difficult to control and further miniaturization of devices is more difficult to accomplish."

From the above description in reference to Figs. 1A through 1G, it is seen that Wang et al teaches difficulties and disadvantages to using titanium/titanium nitride as an anti-reflective coating and/or etch stop. Applicant believes that this constitutes a teaching away from the feature of Applicant's claimed invention as recited in Amended Claim 1 whereby an anti-reflective coating of titanium nitride is used. Further, Applicant believes that the remaining cited art of Rhodes et al, Huang et al, Liu, and Pangrie et al do not teach or suggest, separately or taken together, the above-described feature of Applicant's claimed invention such that one skilled in the art at the time of the invention could practice the claimed invention.

In light of the above, Applicant believes that Claim 1 should not be rejected under 35 USC 103(a). Further, Claims 2-3 and 6 represent patentably distinct, further limitations on Claim 1 that should likewise not be rejected under 35 USC 103(a).

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Reconsideration of Claims 1-3 and 6 rejected under 35 U.S.C. 103(a) as being unpatentable over Rhodes et al (U.S. 4,536,951) in view of Huang et al (U.S. 6,180,509) and in view of Liu (U.S. 5,693,568) and Pangrie et al (U.S. 6,713,382 B1) is requested based on the above remarks.

Reconsideration of Claims 7 and 8 rejected under 35 U.S.C. 103(a) as being unpatentable over over Rhodes et al (U.S. 4,536,951) in view of Huang et al (U.S. 6,180,509) in view of Liu (U.S. 5,693,568) and Pangrie et al (U.S. 6,713,382) and further in view of Wang et al (U.S. 6,080,660) is requested based on Canceled Claims 7 and 8 and on the following remarks.

Due to the amendment of Claim 1, Claims 7 and 8 have been canceled as now redundant. Therefore, the rejection of Claims 7 and 8 under 35 USC 103(a) are moot.

Reconsideration of Claims 7 and 8 rejected under 35 U.S.C. 103(a) as being unpatentable over over Rhodes et al (U.S. 4,536,951) in view of Huang et al (U.S. 6,180,509) in view of Liu (U.S. 5,693,568) and Pangrie et al (U.S. 6,713,382) and further in view of Wang et al (U.S. 6,080,660) is requested based on Canceled Claims 7 and 8 and on the above remarks.

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Reconsideration of Claims 9-12 and 15 rejected under 35 U.S.C. 103(a) as being unpatentable over Rhodes et al (U.S. 4,536,951), in view of Ye et al (U.S. 6,080,529), in view of Liu (U.S. 5,693,568), in view of Pangrie et al (U.S. 6,713,382) is requested based on Amended Claim 9 and on the following remarks.

Applicant has amended Claim 9 in similar fashion as Amended Claim 1. In particular, Amended Claim 9 now reads:

9. (Currently Amended) A method of forming self-aligned, anti-via interconnects in an integrated circuit device comprising:

providing a semiconductor substrate;

5 depositing a first metal layer overlying said semiconductor substrate;

depositing an etch stop layer overlying said first metal layer wherein said etch stop layer comprises a tantalum containing film;

10 depositing a second metal layer overlying said etch stop layer;

depositing an anti-reflective coating layer comprising titanium nitride overlying said second metal layer;

etching through said second metal layer, said etch

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15 stop layer, and said first metal layer to form connective lines;

thereafter etching through said second metal layer to form vias;

thereafter depositing a dielectric layer overlying
20 said vias, said connective lines and said semiconductor substrate wherein said dielectric layer is SiOF (fluorinated silica glass), SiOC (C-substituted siloxane), amorphous SiC:H, MSQ (methylsilsesquioxane), porous materials, PPXC polymer (poly(chloro-p-xylylene), PPXN
25 polymer (poly-p-xylylene), or VT-4 (tetrafluoro-p-xylylene); and

polishing down said dielectric layer to complete said self-aligned, anti-via interconnects in the manufacture of the integrated circuit device wherein said anti-reflective
30 coating layer is a polishing stop.

As described above, the cited art of Rhodes et al, Ye et al, Liu, and Pangrie et al do not teach or suggest the limitation added to Claim 9 by amendment. Further, the additionally cited art of Wang et al appears to teach against the anti-reflective coating as described by Applicant's claimed invention. Therefore, Applicant believes that Amended Claim 9 should not be rejected under 35 USC 103(a). Further, Claims 10-

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12 and 15 represent patentable further limitations on Amended Claim 9 and should not be rejected under 35 U.S.C. 103(a) if Claim 9 is not rejected.

Reconsideration of Claims 9-12 and 15 rejected under 35 U.S.C. 103(a) as being unpatentable over Rhodes et al (U.S. 4,536,951), in view of Ye et al (U.S. 6,080,529), in view of Liu (U.S. 5,693,568), in view of Pangrie et al (U.S. 6,713,382) is requested based on Amended Claim 9 and on the above remarks.

Reconsideration of Claims 18-21 and 23 rejected under 35 U.S.C. 103(a) as being unpatentable over Rhodes et al (U.S. 4,536,951), in view of Ye et al (U.S. 6,080,529), in view of Liu (U.S. 5,693,568), in view of Wang et al (U.S. 6,080,660), and in view of Pangrie et al (U.S. 6,713,382) is requested based on the following remarks.

As discussed above with respect to Claim 1, Applicant believes that the Examiner has cited Wang et al as prior art to the feature of an anti-reflective coating as recited in Claim 18. However, as further described above, Applicant believes that Wang et al actually teaches against this usage of the titanium nitride material based on the cited section. Applicant further believes that the cited art of Rhodes et al, Ye et al, Liu, Wang

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et al, and Pangrie et al do not teach or suggest this feature of Applicant's claimed invention, as recited in Claim 18, such that one skilled in the art at the time of the invention could practice this invention. Therefore, Applicant believes that Claim 18 should not be rejected under 35 USC 103(a). Further, Claims 19-21 represent patentably distinct, further limitations on Claim 18 that should not be rejected under 35 USC 103(a).

Reconsideration of Claims 18-21 and 23 rejected under 35 U.S.C. 103(a) as being unpatentable over Rhodes et al (U.S. 4,536,951), in view of Ye et al (U.S. 6,080,529), in view of Liu (U.S. 5,693,568), in view of Wang et al (U.S. 6,080,660), and in view of Pangrie et al (U.S. 6,713,382) is requested based on the above remarks.

Applicants have reviewed the prior art made of record and not relied upon and have discussed their impact on the present invention above.

Allowance of all Claims is requested.

It is requested that should the Examiner not find that the Claims are now Allowable that the Examiner call the undersigned at 989-894-4392 to overcome any problems preventing allowance.

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Respectfully submitted,

A handwritten signature in cursive script, appearing to read "Douglas R. Schnabel".

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